



SUBSTITUTE SPECIFICATION

DIRECTORY SERVER SYSTEM FOR STORING HISTORY INFORMATION

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BACKGROUND OF THE INVENTION

The present invention relates to a directory server system for storing history information, and more particularly to a directory server system for extending a service interface
10 to users.

The conventional directory server system allows a user to access information about present or current states of users and equipment registered on the server. Namely, the conventional directory server system stores only information about present
15 or current states of users and equipment registered on the server. The user is unable to obtain the history about the states of the registered users or equipment and also is unable to confirm the exact renewal dates.

In the above circumstances, it had been required to develop
20 a novel directory server system free from the above problem.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a novel directory server system free from the above
25 problems.

It is a further object of the present invention to provide a novel directory server system for storing history about the states of the registered users or equipment.

It is a still further object of the present invention
5 to provide a novel directory server system for storing the exact renewal dates of the states.

It is yet a further object of the present invention to provide a novel directory server system for providing renewed information about history of the states of the registered users
10 or equipment.

The present invention provides a directory server system that includes a directory server for storing an attribute of an entry, an entity monitor connected to the directory server for monitoring an entity so that if a change in a state of the entity
15 appears the entity monitor instructs the directory server to renew an attribute of a corresponding entry to the entity, and a directory renewal history storage device connected to the directory server for storing a renewed attribute of the entry as attribute renewal history information.

20 The above and other objects, features and advantages of the present invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments according to the present invention will be described in detail with reference to the accompanying drawings.

5 FIG. 1 is a block diagram illustrative of a structure of a novel directory server system in a first embodiment in accordance with the present invention.

DISCLOSURE OF THE INVENTION

10 The present invention provides a directory server system that includes a directory server for storing an attribute of an entry, an entity monitor connected to the directory server for monitoring an entity so that if a change in a state of the entity appears the entity monitor instructs the directory server to renew
15 an attribute of a corresponding entry to the entity, and a directory renewal history storage device connected to the directory server for storing a renewed attribute of the entry as attribute renewal history information.

 It is preferable to further include a time-correspondent
20 directory server connected to both the directory server and the directory renewal history storage device for confirming an existence of a target entry on the directory server, so that if the existence of the target entry on the directory server could be confirmed, then the time-correspondent directory server
25 obtains the attribute renewal history information from the

directory renewal history storage device.

It is preferable to furthermore include a directory purging entry storage device connected to the directory server, the directory renewal history storage device and the
5 time-correspondent directory server for storing an entry corresponding to an absent entity which has become absent from the directory server.

It is moreover preferable that if the entity becomes absent, then the attribute renewal history information of a corresponding
10 entry to the absent entity is deleted from the directory renewal history storage device, and in place the directory purging entry storage device stores the attribute renewal history information.

It is preferable to moreover include a time-correspondent directory client connected to the time-correspondent directory
15 server for sending the time-correspondent directory server a request for obtaining attribute history information at a past time of an entry from the time-correspondent directory server in order to refer the attribute history information at the past time.

20 It is also preferable that if the request from the time-correspondent directory client is free of any access right, then the time-correspondent directory server rejects the request and sends the time-correspondent directory client a notice to the effect that the request is illegal.

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It is preferable to further include a time-correspondent directory client connected to the time-correspondent directory server for sending the time-correspondent directory server a request for obtaining attribute history information during a past
5 time period of an entry from the time-correspondent directory server in order to refer the attribute history information during the past time period.

It is furthermore preferable that if the request from the time-correspondent directory client is free of any access
10 right, then the time-correspondent directory server rejects the request and sends the time-correspondent directory client a notice to the effect that the request is illegal.

It is also preferable that the directory renewal history storage device also stores renewal time and date together with
15 the renewed attribute of the entry as attribute renewal history information.

PREFERRED EMBODIMENT

A first embodiment according to the present invention
20 will be described in detail with reference to the drawings. FIG. 1 is a block diagram illustrative of a structure of a novel directory server system in a first embodiment in accordance with the present invention. The novel directory server system has the following structure. A directory server 1 is provided for storing attribute
25 information of entries. An entity status monitor 2 is connected

to the directory server 1 for monitoring the change of states of the entity 7 which corresponds to registered users or equipment, so that the entity status monitor 2 renews the attribute information of the entries stored in the directory server 1 upon
5 change of the states of the entity 7. A directory renewal-history storage device 3 is connected to the directory server 1 for storing renewal dates and renewed content of the directory server 1. A directory purging entry storage device 6 is connected to both the directory server 1 and the directory renewal-history storage
10 device 3 for storing all of the attribute renewal history information for an absent entry on the directory server 1, wherein the absent entry corresponds to the past-entity 7 which is currently absent. A time-correspondent directory server 4 is connected to the directory server 1, the directory renewal-history
15 storage device 3 and the directory purging entry storage device 6 for generating attribute renewal history information. A time-correspondent directory client 5 is connected to the time-correspondent directory server 4 for obtaining the attribute renewal history information from the time-correspondent
20 directory server 4 and displaying the same.

Operation of the above novel directory server system will be described. The entity status monitor 2 continuously or periodically monitors the service state of the entity 7. If any change in the service state of the entity 7 appears, then the
25 attribute of the entry corresponding to the entity 7 is renewed

by the directory server 1, wherein the entry is stored in the directory server 1. The directory server 1 sends the renewal date and the renewed contents to the directory renewal-history storage device 3, so that the directory renewal-history storage device
5 3 stores the renewal date and the renewed contents.

The time-correspondent directory client 5 sends the time-correspondent directory server 4 a request for the past state of the entry on the directory server 1, so that the time-correspondent directory server 4 couples the information
10 from the directory server 1 to the information from the directory renewal-history storage device 3 for sending only the requested information about the past state of the entry, whereby the time-correspondent directory client 5 receives the past state of the entry from the time-correspondent directory server 4.

15 The following description will focus on the detailed operation of the above directory server system. The entity status monitor 2 receives information about a change of the state of the entity 7. The entity status monitor 2 instructs the directory server 1 to renew the attribute information of the entry
20 corresponding to the entity 7, wherein the entry exists on the directory server 1. The renewed information on the directory server 1 is sent to the directory renewal-history storage device 3 and stored in the directory renewal-history storage device 3.

If the entity 7 becomes absent, then the entity status
25 monitor 2 instructs the directory server 1 to send the directory

purging entry storage device 6 the entry corresponding to the entity 7, whereby the entry is deleted from the directory server 1, so that the directory purging entry storage device 6 stores the entry. Further, the directory purging entry storage device 5 6 obtains all attribute renewal history information of the target entry from the directory renewal-history storage device 3 in order to store all the attribute renewal history information, wherein the history information of the target entry is deleted from the directory renewal-history storage device 3.

10 The time-correspondent directory client 5 sends the time-correspondent directory server 4 a request for information about a past state at a past time of the entry on the directory server 1 or information about change of the past state in a past time period. The time-correspondent directory server 4 receives 15 this request from the time-correspondent directory client 5, so that the time-correspondent directory server 4 confirms whether or not the target entry currently exists in the information on the directory server 1. If the target entry exists, then the time-correspondent directory server 4 obtains the attribute 20 renewal history information from the directory renewal-history storage device 3. If the target entry does not exist currently in the informations on the directory server 1, then the time-correspondent directory server 4 confirms whether or not the target entry exists in the directory purging entry storage 25 device 6. If the target entry exists, then the time-correspondent

directory server 4 obtains information of the purging entry from the directory purging entry storage device 6. After the time-correspondent directory server 4 has obtained the information, then the time-correspondent directory server 4 sends/
5 the time-correspondent directory client 5 the requested time-correspondent information.

If it is necessary to prepare the entry on the directory server 1 in correspondence with the entity 7 for the supervisor for supervising the change of the state or for the equipment,
10 then the manager of the director server 1 sets the entity status monitor 2 so that the entity status monitor 2 monitors the state change of the entity 7. The entry preparing information on the directory server 1 is stored as an initial state information of the entity 7 on the directory renewal-history storage device 3,
15 wherein access rights are set to the individual entries of the directory renewal-history storage device 3.

If the state change appears on the entity 7, then the entity status monitor 2 obtains the state change information and instructs the directory server 1 to renew the attribute
20 information of the entry corresponding to the entity 7 so that the attribute renewal information of the entry is stored in the directory renewal-history storage device 3.

If it is necessary to delete the entry on the directory server 1 in correspondence with the entity 7 for the supervisor
25 for supervising the state change or the equipment, then the manager

for the directory server 1 releases the entity status monitor
2 from monitoring the state change information of the entity 7.
The information of the entry deletion from the directory server
1 is stored in the directory renewal-history storage device 3
5 and concurrently the directory renewal-history storage device
3 sends the directory purging entry storage device 6 all of the
attribute renewal history information of the target entry. The
access right to the history information in the directory
renewal-history storage device 3 is succeeded to the purging entry
10 on the directory purging entry storage device 6.

If a directory service user wishes to know a past state
at a past time of the entry on the directory server 1, then the
directory service user operates the time-correspondent directory
client 5 to send the time-correspondent directory server 4 a
15 request for obtaining the information about the past state by
utilizing a Search Request of LDAP provided under the following
RFC2251 of IETF. An "X-search At Time" attribute filter is
additionally specified in response to Attribute value Assertion
under Filter Equality Match Rule in order to designate the date
20 and time of the search target of the search target entry, wherein
"X-search At Time" accords to the syntax
(1.3.6.1.4.1.1466.115.121.1.24 DESC 'Generalized Time').

The time-correspondent directory server 4 removes the
"X-search At Time" from the received Search Request Filter to
25 obtain the Search Request of LDAP, so that the time-correspondent

directory server 4 utilizes the Search Request of LDAP in order to confirm the existence of the entry in the directory server 1. If the existence of the entry is confirmed, then the time-correspondent directory server 4 obtains the attribute renewal history information of the entry from the directory renewal-history storage device 3, so that the time-correspondent directory server 4 forms attribute information at a time when the request is issued, in order to respond to the time-correspondent directory client 5. If the directory service user has no access right to the attribute renewal history information of the entry, then the time-correspondent directory server 4 rejects the request and sends the time-correspondent directory client 5 an error response which indicates that the request is illegal.

15 If the time-correspondent directory server 4 could not confirm the presence of the target entry on the directory server 1, then the time-correspondent directory server 4 attempts to confirm the presence of the target entry on the directory purging entry storage device 6 in order to confirm whether or not the target entry has already been deleted from the directory server 1. If the target entry does not exist on the directory purging entry storage device 6 or if the directory service user has no access right, then the time-correspondent directory server 4 rejects the request and sends the time-correspondent directory client 5 an error response which indicates that the request is

illegal. If the target entry is present on the directory server 1, then the time-correspondent directory server 4 obtains the attribute renewal history information of this entry, so that the time-correspondent directory server 4 forms attribute information at a time when the request is issued, in order to respond to the time-correspondent directory client 5. If the entry has been deleted at the time when the request was issued, then the time-correspondent directory server 4 sends the time-correspondent directory client 5 both a notice to the effect that the entry has already been deleted and a final state of the entry.

If a directory service user wishes to know a past state history during a past time period of the entry on the directory server 1, then the directory service user operates the time-correspondent directory client 5 to send the time-correspondent directory server 4 a request for obtaining the information about the past state history by utilizing a Search Request of LDAP provided under the following RFC2251 of IETF. Both an "X-search Start Time" attribute filter and an "X-search End Time" attribute filter are additionally specified in response to Attribute value Assertion under Filter Equality Match Rule in order to designate both the start date and time of starting the search target of the search target entry and the end date and time of ending the search target of the search target entry, wherein "X-search At Time" and "X-search End Time" accord to the

syntax (1.3.6.1.4.1.1466.115.121.1.24 DESC 'GeneralizedTime').

The time-correspondent directory server 4 removes the "X-search Start Time" and "X-search End Time" from the received Search Request Filter to obtain the Search Request of LDAP, so
5 that the time-correspondent directory server 4 utilizes the Search Request of LDAP in order to confirm the existence of the entry in the directory server 1. If the existence of the entry could be confirmed, then the time-correspondent directory server 4 obtains the attribute renewal history information of the entry
10 from the directory renewal-history storage device 3, so that the time-correspondent directory server 4 forms attribute information at the started time of the requested time period and a post attribute renewal history information, in order to respond to the time-correspondent directory client 5. If the directory
15 service user has no access right to the attribute renewal history information of the entry, then the time-correspondent directory server 4 rejects the request and sends the time-correspondent directory client 5 an error response which indicates that the request is illegal.

20 If the time-correspondent directory server 4 could not confirm the presence of the target entry on the directory server 1, then the time-correspondent directory server 4 attempts to confirm the presence of the target entry on the directory purging entry storage device 6 in order to confirm whether or not the
25 target entry has already been deleted from the directory server

1. If the target entry does not exist on the directory purging
entry storage device 6 or if the directory service user has no
access right, then the time-correspondent directory server 4
rejects the request and sends the time-correspondent directory
5 client 5 an error response which indicates that the request is
illegal. If the target entry is present on the directory server
1, then the time-correspondent directory server 4 obtains the
attribute renewal history information of this entry, so that the
time-correspondent directory server 4 forms attribute
10 information for the requested time period and the attribute
renewal history information, in order to respond to the
time-correspondent directory client 5. If the entry has been
deleted before the requested time period, then the
time-correspondent directory server 4 sends the
15 time-correspondent directory client 5 both a notice to the effect
that the entry has already been deleted and a final state of the
entry.

Accordingly, the above described novel directory server
system allows the user to operate the time-correspondent directory
20 client to refer the attribute renewal history information on the
renewed directory server 1, thereby obtaining the past-entry on
the directory server 1 and the informations about the status
changes of the person or equipment which corresponds to the entry.

Whereas modifications of the present invention will be
25 apparent to a person having ordinary skill in the art, to which

the invention pertains, it is to be understood that embodiments
as shown and described by way of illustrations are by no means
intended to be considered in a limiting sense. Accordingly, it
is to be intended to cover by claims all modifications which fall
5 within the spirit and scope of the present invention.